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Robot warriors: why the Western investment into military robots might backfire

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Robot Warriors

Why the Western investment into military robots might backfire

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Summary

Since the turn of the millennium, when Unmanned Aerial Vehicles (UAVs) and robots first began to gain special attention in the US military, a veritable boom of robotization has ensued. Currently, more than 45 states are developing UAVs or already have them, and interest continues to grow. For drones are especially suited to carry out tasks that are dirty, dull, or dangerous, and can complement the capabilities of any of the world's armies in interesting ways.

Two trends are especially noticeable: The first is the trend to weaponize unmanned platforms and thus to achieve a force multiplier that makes coordination between reconnaissance and shooter obsolete. The second is the trend towards greater autonomy of the system, i.e., away from remote piloting towards remote control of systems that increasingly act without human assistance.

Although all countries worldwide have an interest in drones, they are particularly tempting for the Western states. This is because drones and robots are exceptionally suitable for minimizing losses among one's own troops by effectively replacing soldiers on the battlefield. Especially against the background of increasing concern in Western public opinion over growing casualties in Iraq and Afghanistan, drones appear to be the "weapon of choice" when it comes to maintaining the "conductibility" of military campaigns. Accordingly, Western states are particularly involved in the development and acquisition of drone technology. At the same time, the increasing use and proliferation of drones also creates problems: For instance, the growing numbers of drones strikes conducted mainly by the CIA in the border area between Pakistan and Afghanistan have caused problems under international law and given rise to considerable disagreement among experts in the assessment of the strikes. Also, the increasing proliferation of drones has a destabilizing effect that should not be underestimated, and it is not difficult to come up with scenarios where possession of drones significantly lowers the inhibition threshold to the use of force involving these platforms. Lastly, there are also ethical concerns, especially when the two trends of arming and automating UAVs become increasingly intertwined. For who ultimately carries responsibility if an automated drone "decides" without human intervention to kill humans? All of these problems and potential dangers indicate the necessity of regulating the increasingly unchecked build-up of UAV armaments by means of arms control policy. It is questionable, however, whether arms control can be enforced if the states that have so far been the strongest advocates of international arms control, such as the Federal Republic of Germany, are currently jumping on the drone bandwagon instead of trying to slow it down. It is therefore important to create an awareness of the necessity of voluntary arms limitation before the current technological advantage enjoyed by the West melts away and the Western countries can no longer call the shots when it comes to initiating arms control efforts.

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"We are programmed just to do
anything you want us to"
(Kraftwerk: The Robots, 1978)

1. Introduction[1]

As Mark Twain famously pointed out, in some cases, reports of death may be greatly exaggerated. This is also true in the military sphere for the Revolution in Military Affairs (RMA), which was mainly advanced by the US and refers to the quest for high-tech weapons systems and the comprehensive networking of these weapons using state-of-the-art information technology. Only a few years ago, it seemed the conflicts in Afghanistan and Iraq had shown that high-tech weapons systems made it easier to win wars between countries, but that the new weapons systems were largely unsuitable for the subsequent asymmetrical guerilla wars and counterinsurgency. "Boots on the ground" seemed to be the solution for Western states trying to regain control of the situation in Iraq and Afghanistan; the pursuit of comprehensive high-tech armies seemed to be inappropriate for the new asymmetrical scenarios of the putative post-war era. However, it is currently becoming clear that core elements of the RMA and the concept of IT-networked warfare have become emancipated from the inter-state scenario. They are also regarded as crucial elements of success in counterinsurgency and counterterrorism. With the soaring deployment of drones, more and more of which are armed (Unmanned Combat Aerial Vehicles, UCAVs), on the battlefields of Iraq, Afghanistan, and increasingly also Pakistan, systems are coming into use that bring together the basic elements of the RMA in a very specific way and that can be regarded as ideal-type weapons according to the concept of military transformation. Thus, the RMA and the transformation of Western armed forces into high-tech armies are by no means obsolete concepts in the minds of military planners. Accordingly, at least in the West, the quest for and deployment of U(C)AVs is driven by the same motives that were also an important impetus for the RMA: a politically motivated desire to conduct military operations in which the own troops are exposed to as little danger as possible. Thanks to robots and drones, the RMA has become ensconced across the entire spectrum of military tasks in the 21st century, and the Western pursuit of military technological superiority will be continued for beyond the foreseeable future. In the course of this development, however, a more accentuated debate will be required on certain risks and dangers that were already associated with the RMA and that have once again become aggravated by the latest developments (Müller/Schörnig 2001; Schörnig 2008). A key factor here is the increasing automation of the battlefield. In this context, U(C)AVs have a key role to play.

1 This report is a significantly expanded and revised version of "Die Automatisierung des Krieges. Der Vormarsch der Robotkrieger ist nicht mehr aufzuhalten und wirft einige Probleme auf", HSFK-Standpunkt 5/2010. I gratefully acknowledge the helpful suggestions by Frank Sauer and Annabel Schmitz.

Thus, this report aims, first of all, to introduce the current state in the field of unmanned systems and to sketch potential development trends. Subsequently, possible dangers and problems arising from an unfettered buildup of unmanned – and in particular, armed – systems will be discussed. Here, a particular focus will be devoted to matters of stability in security policy and international law as well as ethical considerations. Specifically, we will discuss the current use of drones by the US in Pakistan. Finally, it will be argued that despite the proven urgent need in this area, the chances of arms control and of limiting the most problematic armed systems are very slim, since consideration is given almost exclusively to short-term advantages of drones and unmanned systems, while long-term problems are ignored. Therefore, this report concludes with an appeal to decision-makers not to miss the opportunity to institute a fundamental regulation of robot armaments as long as it is the Western states that dominate their development.

2. Robot warriors – the trend towards automated combatants

Robots have become the established symbol of a future that is not too far off, but still distant enough for observers to believe they do not require serious attention yet. Most people still regard robots as *science fiction* that has little connection to reality.

When unwitting observers are told what current robot prototypes are already capable of doing, they usually respond with incredulous amazement. For the future has already arrived, and in some areas, real-life developments have already caught up with or even surpassed the Hollywood visions that still dominate the fantasies of many. Even if robots suffering from depression or phobias, like "Marvin" and "C-3PO", are not expected to become reality for the foreseeable future, the development of unmanned systems that can be regarded as robots in a more general sense has been an unbelievable success in recent years. They are deployed in environments ranging from the sea floor, where they try to seal off oil pipelines, to outer space, where they take pictures on Mars and collect and analyze soil samples, for example. They crawl through conduits seeking out leaks; and, at least in Japan, they assist and entertain elderly citizens.

The armed forces, in particular, have a growing interest in such "machines". On missions that are "dirty, dull, and dangerous", it seems that machines are almost infinitely more suited than humans. Their triumphant success can be best observed in the current theaters of operations in Afghanistan and Iraq. The armed forces' use of unmanned systems has dramatically increased in recent years. Especially the technologically advanced armed forces of the US are increasingly relying on weapons systems that, although basically remote-controlled, mostly already operate semi-autonomously: Between 2003 and 2009, for instance, the number of UAVs increased from just a handful to more than 7,000 (Singer 2009b). On the ground, the development has been even more drastic: While the US arsenal in 2003 included practically no ground-based robots at all, the armed forces had been supplied with over 12,000 robots by 2009 (Singer 2009b).

Although the US is by far the most advanced state in the areas of research, development, acquisition, and deployment, more and more other countries worldwide are trying at least to keep up with parts of this development and either to develop robotic systems of their own or to import such systems. Besides the US, it is mainly other Western states that are committed to arming themselves with robotic systems. However, some non-Western states are also part of this development – to the extent that their national industries allow. This is particularly true for the technologically advanced countries of China, Russia, or Singapore, but also Iran or Pakistan. However, as also confirmed by documents recently released by Wikileaks, drones top the procurement lists of many countries (Rawnsley 2010). There are more than 45 countries that are either developing their own UAVs or have deployed systems procured on the open market. Nevertheless, it is the Western countries, and foremost among them the US and Israel, that are driving the dynamic of ever more sophisticated and complex systems and have thus set in motion a new arms spiral. For it is the states of the West that appear to benefit most from the use of military robots, as they are apparently particularly suitable for conducting military operations without own casualties. However, the negative effects of this arms spiral for international security are forgotten and ethical problems are consciously ignored. Accordingly, we can expect to see more and more combat robots on the world's battlefields in the future. The robot genie that was summoned now refuses to return to the bottle.

2.1 Robots currently used in military arsenals

Drones and automated systems are now available for all branches of the armed forces (army, air force, and navy). They range from minute machines that are easy to transport, and are in some cases only a few dozen centimeters in size, to robots the size of small cars or even small commercial aircraft. But robots the size of insects are also being constructed. One particularly significant development is that of unmanned reconnaissance aircraft. These drones are used to loiter above a predefined area with a large array of sensors (infrared/optical, radar) and transmit real-time reconnaissance data to the control station. In this task, they are clearly superior to the traditional reconnaissance platforms of satellites or aircraft: Unlike manned surveillance aircraft, depending on their size and specialization, drones can remain airborne considerably longer (the US military's Global Hawk has a maximum endurance of up to 36 hours) and circle an area at relatively low speed, with pilots taking turns in regular shifts at the control station. Satellites, on the other hand, can only reconnoiter a given area for brief intervals during their orbit, or – if they are geostationary satellites that can remain above a certain area in synchronicity with the earth's rotation – they must be brought into position above the target area in a highly elaborate maneuver, which means that other areas escape their electronic gaze. Modern drones have stabilized camera systems that can in many cases deliver remarkably detailed imagery even from a distance of several kilometers and can monitor entire towns. Increasingly, however, ever smaller UAVs can also carry state-of-the-art Semi-Aperture Radar (SAR) systems that provide a clear picture of conditions on the ground, independently of weather, cloud cover, or fog. Unmanned

drones can also be used as radio relay stations, however, expanding the relatively limited data bandwidth of military satellites. Since more and more countries have counter-satellite weapons at their disposal, drones are also a fallback in case of attacks on military satellites.[2]

However, the relatively slow-flying drones are fairly vulnerable to anti-aircraft fire and are easy to discover by radar due to their arrays of sensors and weapons, which are usually attached to the outside of their hulls. While this is not a problem in uncontested airspace such as in Afghanistan, for example, drones would be considerably more exposed in a conflict with a better-equipped adversary. This is why many next-generation drones, such as the Avenger presented by the US in 2009 or the British Taranis, due to be presented in 2011, are constructed in such a way as to be somewhat stealthy, making them harder to detect by radar (Shachtman 2010b). Surveillance drones are the unseen eyes of the military in the sky, and no contemporary army can dispense with their services.

If those UAVs were the vanguard, ground-based systems are now catching up. Systems for remote-controlled defusing of bombs or explosive devices are held in particularly high regard. Since so-called Improvised Explosive Devices (IEDs) emerged as the primary threat to Western forces in Afghanistan and Iraq, robots are being increasingly deployed to defuse these traps. This practice is also established in national counterterrorism, and police forces in the UK, Israel, and Germany have been using individual robots against explosives for several decades. This practice has by now become widespread. However, it is expected that ground-based systems will increasingly also be used for other purposes: Intense work is ongoing in developing capabilities to explore buildings in built-up battlefield environments or to carry material through dangerous terrain. Initial prototypes are already being used for guard and patrol duties (Shachtman 2010d). However, the real current stage of development is lagging behind the designers' visions, and many robotized land-based systems are clearly still far from being mature applications.

Many of the current systems, whether land-based or airborne, are characterized by the fact that core functionalities continue to be controlled by cable, radio, or satellite link. It is for all practical purposes irrelevant in this context whether the ground control station is in close proximity or tens of thousands of kilometers away. Many drone missions in Afghanistan or Iraq, for instance, are controlled by "pilots" in the US who return home to their families after their drone's mission has ended. In the meantime, however, electronic technology is taking over more and more of the pilots' tasks. This is also why remote-controlled systems today can act with a great deal more autonomy than only a few years ago. The developers' goal is for an increasing number of tasks to be carried out automatically and without human intervention (Krishnan 2009: 34-46). It has become almost commonplace by now for drones to navigate autonomously into predetermined

2 Since most drones are guided by the Global Positioning System (GPS), an attack on GPS satellites would be the logical consequence.

target areas, where they observe the terrain in accordance with prearranged routines. Some systems no longer even require human intervention during complex maneuvers such as takeoff and landing. Human pilots need only monitor events and intervene in case of unforeseen events; in operative terms, the system conducts its routine tasks near-autonomously. Of course, even such "autonomous systems" are far removed from making complex decisions on their own; they act in accordance with sophisticated algorithms that are integral parts of their operating programs. For the military, such programmed autonomy has the advantage that the system no longer needs to be monitored constantly. Already today, one operator can handle several drones concurrently. If current developments continue, it is conceivable that in the future, the operational headquarters will only specify the mission, leaving the robot to work out the path and procedures autonomously.

2.2 Upgrading to robot warriors

It should come as no surprise that after the first successful reconnaissance missions, it did not take long for the first armed drones to be deployed. As early as 2002, MQ-1 Predator drones equipped with two Hellfire antitank missiles attacked targets in Afghanistan and Yemen. Today, in addition to the Predator – which is now being phased out – the armed successor model MQ-9 Reaper is increasingly being deployed, with a maximum payload of 1'700 kg that allows it to carry significantly more ordnance. The Reaper can carry up to ten missiles, or alternatively deploy heavier bombs.[3] The military advantages of an armed drone are immense: Thanks to the precision of modern missiles, targets can now be attacked almost in the very instance in which they are identified. The drone is a dangerous loitering weapon, as the time gap between reconnaissance and attack, or "sensor to shooter gap", is for all practical purposes reduced to the remote pilot's reaction time, or the time needed to get permission to attack from a higher-ranking officer.

It is thus becoming apparent that the human factor is the last remaining limitation, since the limited cognitive faculties of the individual are no longer sufficient to process the flood of information and to make immediate decisions. Therefore, from the military perspective of deploying weapons with maximum efficiency, there are many reasons for giving even more autonomy to robots in the future – up to and including developing algorithms that make decisions on whether to deploy live ordnance without having to wait for human authorization.

In view of the operational advantages, armed attack drones have developed into one of the key weapons for combating insurgents, al-Qaida, and the Taliban in Afghanistan, Iraq, and in Pakistan, although they are still controlled by human operators today. Ground-based robots are also being equipped with weapons, at least experimentally. For

3 U.S. Air Force, MQ-9 Reaper, 18.8.2010, www.af.mil/information/factsheets/factsheet.asp?id=6405 (11.1.2011).

instance, South Korea's border with the North is patrolled by robots that can also deploy firearms in response to an officers' radio signal. However, after initial tests of armed Talon robots (designated as Special Weapons Observation Reconnaissance Detection Systems – SWORD), the US military has concerns about allowing armed robots to go on patrol together with soldiers due to fears of uncontrolled behavior or system failure (Krishnan 2009: 29). However, the problems here are seen to be mainly technical in nature and can be resolved with improved software. Therefore, land-based robots can also be expected to be given more autonomy. Advocates assert that correctly programmed robots will act dispassionately even in dangerous situations – e.g., under hostile fire or in a heated atmosphere – and will not allow themselves to be drawn into using excessive force or turn their weapons on unarmed people (Arkin 2009). What is critical here, though, is the ability to discriminate between combatants and non-combatants. Members of the military hurry to affirm that as long as there are no reliable programs than can do so, the ultimate decision on deploying weapons would always remain in human hands, even though off the record, the argument is frequently advanced that it is precisely the removal of human agency from the chain of responsibility that brings the greatest advantages. In 2006, a group of Pentagon experts even concluded that drones should be given more autonomy of decisionmaking when it came to deploying weapons (Trimble 2006). So far, however, the group has not been able to win through within the Pentagon.

2.3 Autonomy and artificial intelligence

But what does autonomy mean exactly in the context of drones, and how far can it be taken? Is it conceivable that military robots will develop a consciousness and – as anticipated in many science fiction scenarios – turn against their creators? In this context, computer experts refer to the so-called "singularity", the point at which the intelligence of computers will surpass human capability through the concurrence of huge computing power and strong artificial intelligence and empower machines to think creatively about problems (Singer 2009a: 100-108). Ultimately, this singularity would mean the emergence of a new consciousness and possibly even induce computers to initiate their own reproduction or even generate better designs for themselves. There is agreement among experts that the phase following upon the singularity could no longer be prognosticated using current means (Chalmers 2010).

However, the expectations of computer experts with respect to real or strong artificial intelligence (AI) with a consciousness of its own have so far proven to be at least exaggerated. Even the most advanced systems are still nowhere near acquiring real intelligence, creativity, or a consciousness of their own. After the researchers' initial euphoria, there are thus doubts once more today as to whether a computer can develop an independent consciousness and, as science fiction author Philip K. Dick put it, "dream of electric sheep". It is currently still very difficult to predict whether the technical barriers to development can be overcome or not. Thus, Wallach and Allen conclude:

"Fully conscious artificial systems with complete human moral capability may perhaps remain forever in the realm of science fiction" (Wallach/Allen 2009: 8).

However, the matter of the singularity is currently of subordinate importance in the development of military systems, since at least at this point, the focus is less on real consciousness, creativity, and intelligence, but rather on pure computing power and calculation of complex algorithms within very short timeframes. And here, the unabated development in microelectronics plays into the hands of the programmers. According to "Moore's Law", which has been in force since the 1960s, the number of transistors on a microprocessor doubles approximately every 18 to 24 months – a nexus that experts believe will remain in effect for the next 15 to 20 years as well.[4] This translates into exponential growth in the capability of electronics to evaluate comprehensive and complex datasets within milliseconds and to react in accordance with the way they are programmed. An "intelligent approach" is not really a crucial requirement here: The fact that the "Deep Blue" computer was able in 1996 to beat the ruling world champion in chess, Garri Kasparov, and even won a tournament the following year, was primarily due to the huge computing capability of the highly specialized computer, which was able to analyze more than 100 million positions per second and assess them in accordance with programmed input. The computer did not *understand* what it was calculating, but was still able to beat its human opponent without an intuitive sense of the positions and the course of the match, simply by virtue of its immeasurably superior calculating power. This ability of course also facilitates the development of ever more complex, i.e., more autonomous drones that can incorporate ever more external parameters into their calculations in ever shorter time.

For instance, if autonomous pathfinding was initially only possible in the air, which is largely free of obstacles and where evasive maneuvers are possible in three dimensions, an increasing number of drones today are easily capable of taking off and landing without human intervention. But also in emergency situations that only the best human pilots are able to cope with, the abilities of autonomous systems come to the fore: The Rockwell Collins company has developed a damage tolerance system that allows damaged drones to return safely to the ground even in extreme situations. Thus, a scaled-down version of an autonomously piloted F-18 was tested by blowing off 80% of one of its airfoils. Within a few seconds, the computer had regained sufficiently secure control of the aircraft to such an extent that the mission could have been continued before safe touchdown without human assistance.[5]

However, it is not only in the air, but also on the ground that systems are distinguished by increasing autonomy: For instance, state-of-the-art ground-based systems are now capable of navigating independently in unknown territory.

4 BBC News, Moore's Law on Chips marks 40th, 18.4.2005, http://news.bbc.co.uk/2/hi/technology/4446285.stm (10.8.2010).

5 DIY Drones, Damage tolerant flight, Rockwell Collins DARPA work, 24.8.2010, http://diydrones.com/profiles/blogs/damage-tolerant-flight (16.9.2010).

In 2005, the driverless vehicle "Stanley" (a redesigned Volkswagen Touareg R5) built by the Stanford Racing Team managed to cover a distance of around 280 km in ten hours without human intervention as part of the "Grand Challenge" race organized by the Defense Advanced Research Projects Agency (DARPA).[6] This achievement was regarded as so remarkable at the time that Stanley was even exhibited for a while after the race at the Smithsonian National Museum of American History in Washington, D.C. Only two years later, the objective of the new "Urban Challenge" competition consisted of driving in ordinary urban traffic while observing the rules of traffic. In this test, too, there were vehicles that successfully completed the challenge. Finally, in 2010, two autonomous cars built by an Italian company, accompanied by manned vehicles, started on a 13,000-km trip to China.[7] This shows that the capability of autonomous navigation – and thus, of autonomous behavior – is increasing dramatically within a short timespan. It is no coincidence that the military is investing large sums in this area and supporting cutting-edge research in robotics.

Overall, therefore, it is notable that the computing capability of modern microprocessors is sufficient to allow rules-based behavior of machines in increasingly complex situations, and is equal to or even greater than human capabilities in specific situations – as illustrated by the ability to steer damaged drones. It is true that this is not autonomous behavior in the philosophical sense of deliberate action, i.e., the machines are not free to decide to violate the way they are coded, and thus their behavior is essentially predictable. However, an ever-growing range of parameters figure in their calculations and are taken into account by the program at constantly decreasing intervals, which means that their interaction makes it extremely difficult in certain situations to predict the machine's behavior, just as the moves of the best chess computers are now, for all practical purposes, unpredictable. This shows that the question of awareness is becoming irrelevant to the extent that the sheer complexity of modern autonomous systems has reached the boundaries of human predictive capabilities.

3. Reasons for the robotics trend in the West

The availability of robots and drones already promises huge advantages to any of the world's armed forces today. Robots do not tire, they carry out orders (so far?) unquestioningly, they do not require lengthy training, and they remain unaffected by boredom or emotional stress. In summary: There are good reasons for generals worldwide

6 Stanford Racing, Latest News, 14.8.2006, http://cs.stanford.edu/group/roadrunner//old/index.html (6.2.2011).

7 Spiegel Online, Roboter rollen von Italien nach China, 23.7.2010, in: www.spiegel.de/netzwelt/gadgets/0,1518,708068,00.html (10.1.2011).

to wish for their own robot armies, and these reasons are frequently characterized by the "Three Ds" – "dirty, dull, dangerous" – as the main characteristics of the types of missions for which robots are particularly suitable. In addition to their strictly military advantages, however, drones in particular are also weapons systems that are regarded as being especially prestigious status symbols. Possession of drones, and even more so the indigenous development of UAVs, are seen in many countries as evidence of modern state-of-the-art armed forces and enhance the international reputation of the country in question. The fact that reputation and status are particularly important factors especially when it comes to procurement of modern weapons systems, irrespective of pure security considerations, has been clearly demonstrated by constructivist research in this context (Eyre/Suchman 1996). The importance attributed by Iran to its first drone, for instance, which the country's President Mahmoud Ahmadinejad has called an "ambassador of death", shows how important it is, at least in a nation's self-perception, to be one of the world's drone-producing countries (Shachtman 2010a). In professional circles, however, the drone – which is more reminiscent of a cruise missile than of a reusable drone – was derided as an "envoy of annoyance" due to the obsolescence of its design and assumed capabilities vis-à-vis Western models (ibid.).

Why, though, is it the Western OECD countries – with the US and Israel in the vanguard – that are driving the development of unmanned systems and also invest the most money in such efforts? In addition to the particular affinity of Western states (in this case, the US and Japan in particular) for technical solutions (Sapolsky/Shapiro 1996), the main reason according to some authors (Carter et al. 2001) is simply the technological capability of the Western industrialized nations, which are leading developers in key areas (electronics, data transmission, precision engineering). From this point of view, recourse to high-tech in the military field is a supply-driven automatism and a technological imperative. The technology is used simply because it is available. However, this line of argument fails to acknowledge that decisions as to which technologies require further research and where the finite funding budgets are dispersed are not the results of automatisms or even chance. Rather, they are expressions of a preference on the part of political decisionmakers, or at least expressions of the conceptions that the arms industry has when it comes to the decisionmakers' preferences.

3.1 Drone warfare as the "new Western way of war"

An alternative explanation that assumes considerably more agency capabilities on the part of political decisionmakers is based on the arguments of Martin Shaw (Shaw 2005), who makes the case that since the end of the Cold War, if not before, the West has been engaged in a "New Western Way of War" (thus the title of one of his books). Shaw argues that Western liberal states can no longer wage classic wars of attrition in which wave after wave of own soldiers are sent onto the battlefield. This is all the more true because the wars of the West since 1990 (possibly excluding the war in Afghanistan that began in 2001) are "wars of choice" – unlike unavoidable defensive wars ("wars of necessity") (Freedman 2006/7; Haass 2009). Unlike a defensive war, such wars of choice are

significantly more controversial domestically, and the potential political costs of participation are high. For research has shown that the populations of Western countries (especially in the US) react with considerably more sensitivity to own losses when the conflicts in question are neither defensive wars nor linked in a clear way to the national interest (Larson 1996). Accordingly, in so-called "world order wars", humanitarian interventions, or wars of democratization, there is little willingness to accept casualties on the own side.

Thus, public opinion in Western countries is increasingly critical, with citizens enquiring why their own soldiers are risking their lives. For political decisionmakers, therefore, own casualties always bring the risk of a reversal in public opinion about a military mission, creating political pressure on the government. This linkage increases together with the impression that goals identified ahead of the mission (democratization, prevention of a humanitarian disaster, etc.) can not be achieved at all, or only slowly (Gelpi et al. 2006). Additionally, due to the global presence of mass media, the West in particular cannot simply accede to military exigencies, but must do justice to its own moral standards.

Against this background, Shaw argues that beyond genuine self-defense, Western countries can only use their armed forces if they avoid risks as far as possible or pass them on to other/third parties and thus minimize their own losses (Shaw 2005: 71-97). The goal must be to engage in so-called "risk-transfer warfare". Of course, there are generally a number of ways to implement risk-transfer warfare. The case of Afghanistan 2001/02 showed that using local troops on the ground, supported by special forces and air power, means almost complete avoidance of own losses. Another alternative is deploying private military companies (PMCs) for especially high-risk operation instead of own troops (Singer 2003). Research has shown, for instance, that deaths of PMC members are practically ignored altogether in US public opinion – or at least in the US media (Schooner 2008). The third alternative is warfare using standoff weapons – an ideal use of armed autonomous drones. They are the ideal weapon if the goal is to attack the enemy with minimal danger to own troops, and – at least in conflicts with qualitatively inferior enemies, and at least for one's own side – they make the dream of "warfare without bloodshed" a reality (Mandel 2004). Shaw does point out that even in risk-transfer warfare, there is an obligation to observe restraint concerning civilians on the other side. However, in a weighting between own troops and foreign civilians, more consideration should be given to own soldiers (Shaw 2005: 84-87). The hierarchy of norms as described here by Shaw has also been supported in the meantime by other researchers (Geis et al. 2010: 187f.).

3.2 Drones as part of the Revolution in Military Affairs

The concept of extending special protection to one's own troops due to technological superiority is of course not limited, or exclusively linked, to drones. Rather, since the Gulf War of 1991 and what was – at least for the US-led alliance – an almost casualty-free victory, there has been an awareness that the comprehensive use of advanced military

technology as part of the RMA makes it possible to keep one's own troops far removed from the actual battlefield or at least to minimize their vulnerability. The RMA involves the use of technologies that had been developed during the Cold War to defend against numerically superior Warsaw Pact armies (Neuneck/Alwardt 2008) and were consistently developed since their first successful deployment in the Gulf: Increasingly precise "smart" laser- or GPS-guided bombs that are deployed from increasing distances against hostile targets and usually achieve direct hits at the first attempt (Koplow 2010: 79-103). The stealth technology, familiar to the general public by now, allows aircraft as well as ground vehicles or vessels to become invisible to radar and thus helps them arrive safe and undetected at their target (Sweetman 2003). Improvements in satellite or drone reconnaissance make it increasingly easy to attack enemies at their most vulnerable point and may help to shorten combat operations considerably. However, the core of the RMA is the networking of all units involved in combat through modern communications technology using satellites and constant exchange of data among these units. The recurrent catchphrase here is "network-centric warfare", which aims to achieve "information superiority" over the opposing side, to lift the "fog of war" and thus to "multiply" the effects of individual weapons systems. Also, individual units are enabled, based on an integrated situation report, to act on their own initiative with only a minimum of centralized guidance as part of a predetermined battle plan.

Although the RMA has not yet been realized completely, even opponents assessed as being relatively capable, but not equipped with the latest generation of weapons systems, such as Iraq or Yugoslavia, have been practically unable to mount an effective threat against Western RMA-enabled armies in open warfare. It is therefore unsurprising that the Pentagon under former secretary of defense Donald Rumsfeld invested huge sums into further upgrades towards equipping armed forces with state-of-the-art technology (O'Hanlon 2002).

In 1998, US expert Lawrence Freedman – impressed by the developments of the RMA – concluded that cruise missiles were the paradigmatic weapons of the RMA, as they could be launched with high precision from a number of platforms and would thus create only slight collateral damage (Freedman 1998: 70). Today, armed drones seem even more suitable to take their place as embodiments of the concept of the RMA, since they combine the four core elements of the latter: As described above, modern drones are increasingly stealthy. They deliver precision munitions rather than heavy bombs while simultaneously carrying out detailed reconnaissance tasks. They are networked and send real-time reconnaissance data to the relevant formations – whether they be headquarters units or ground troops under hostile fire. They serve as radio relays and thus also facilitate networking, of which they themselves are an integral part. They protect own troops and diminish casualties among the civilian population – though they are not as effective in the latter task as the military would frequently have one believe (see below). To sum up: Drones are today the ultimate paradigmatic weapon of the RMA.

Additionally, drones are even, or perhaps especially, capable of transferring the fundamental concept of the RMA – the domination of opponents by means of technological superiority with minimal own losses – to scenarios beyond classic warfare.

For the period following the occupation of Iraq and the conquest of Afghanistan showed that while the West can now conduct warfare with very few own casualties (Boot 2006: 318-384), modern fighter aircraft and GPS-guided precision bombs are only of limited suitability for the subsequent period when the opposing side switches to guerilla warfare and terrorism (Biddle 2004; Daase 2008). Since the adversary then no longer has any military infrastructure such as radar installations, airports, or bunkers that can be just as easily reconnoitered by satellite, the need for real-time reconnaissance of concrete activities has once more steeply increased. UAVs in particular are considered by many US experts to be ideal weapons for counterinsurgency and counterterrorism efforts due to their ability to loiter for extended periods while monitoring large areas and attacking identified targets at short notice. Patrols that come under attack, it is argued, can get a better sense of their situation from drones and react to the enemy in a more targeted manner. Since drones are also fairly cheap products compared to manned systems, they have greater leeway in making low passes over the adversary's positions and drawing anti-aircraft fire in order to get even better surveillance images. In the meantime, Western armed forces will even deploy drones for comprehensive airborne surveillance in humanitarian missions.[8]

3.2 Drones in classic warfare: The aspect of international law

Armed drones are therefore the apex of the RMA, which aims to achieve military advantages through technological superiority in classic conflicts between states. But what about the admissibility of a drone war under international law? Experts in the law of nations generally agree that deploying a *remote-controlled* drone on the battlefield as part of a classic inter-state war is at least not reprehensible per se under international law (Anderson 2010; O'Connell 2010). For international humanitarian law, or *ius in bello*, only bans the use of especially cruel weapons where the creation of unnecessary suffering is unavoidable, and of non-discriminating weapons that affect combatants and non-combatants alike. The fact that land mines create considerable danger for the civilian population *after the end* of a conflict laid the groundwork for the uniquely successful campaign to ban anti-personnel mines that finally led to the Ottawa Convention, which has been accepted by nearly all countries. These arguments can be transferred, for instance, to non-exploded cluster bombs, which also pose a considerable threat to the civilian population. However, the protection of civilians is not absolute, but is subject to the rule of proportionality. For instance, civilian casualties may be hazarded if the attack is aimed at a military target and is "proportional" to the expected military advantage (Cohen 2010). However, the question of how many casualties can be considered proportional in a concrete case leaves considerable leeway for interpretation. Many

8 Nautilus Institute Australia, Unmanned aerial Vehicles, http://gc.nautilus.org/Nautilus/australia/australia-in-solomon-islands/unmanned-aerial-vehicles-uavs (11.2.2011).

experts in international law and military professionals believe that armed drones do not constitute disproportionate weapons – indeed, they claim the opposite is the case. First of all, drones are strictly speaking not weapons, but weapons platforms, just as an airplane as such is not a weapon until it is equipped with machine guns or rockets. But even if the drone and the rocket are regarded as a single functional unit, its ability to deliver highly precise surveillance combined with highly precise effects appears to make it particularly suitable for meeting the conditions of the proportionality requirement.

Although the latest models of drones can, as noted above, also be equipped with bombs specifically designed for greater destructive effect, they do not differ from those that are also dropped by manned fighter jets. However, it seems to be the exception rather than the rule for them to carry bombs rather than PGMs. The key question in this context is whether the bomb or missile is "proportional" to the target under attack, independently of the nature of the platform by which it is delivered. According to unconfirmed reports, US government agencies are developing smaller 35-pound ordnance that would deliver reduced explosive power for even more limited, and thus more precise attacks. Finally, the pilots of the US Air Force at least follow strict rules of engagement that only permit air strikes if a comprehensive check, which even includes computer simulations of traffic patterns and the expected effects of the bomb, suggests minimal civilian casualties. If there is sufficient time to complete the entire scrutiny process (which may not always be the case with sudden deployments, for instance, when own troops unexpectedly encounter hostile forces), even Human Rights Watch concludes that drone attacks only "rarely" cause civilian casualties (Human Rights Watch 2008: 4).

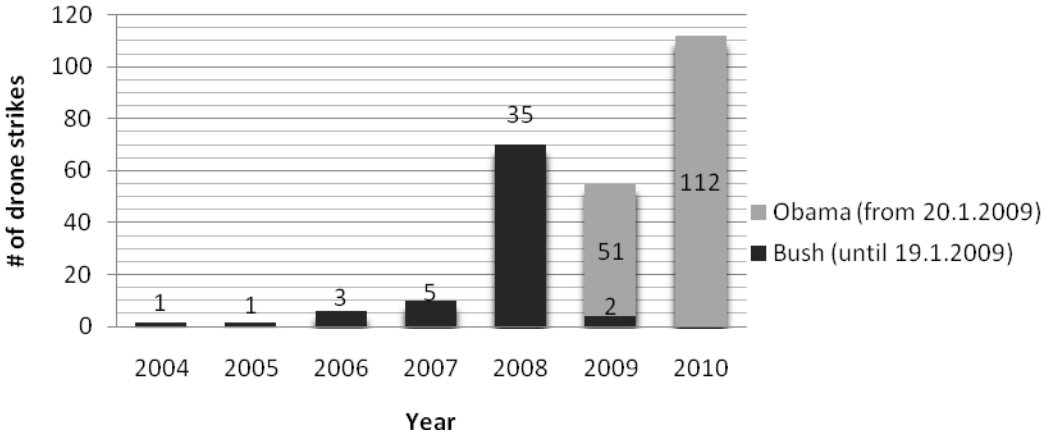
4. The dark side of drone warriors

4.1 An "undeclared" drone war in Pakistan?

In the past two years, the use of armed drones has increasingly come to the attention of the public. However, this was due not, as might be assumed, to the use of military drones in Afghanistan, but to attacks that were and are still being carried out with drones in Pakistan's tribal areas of Waziristan near the Afghan border. Unlike drone attacks in Afghanistan, the operations in Pakistan are by now very well documented, despite a persistent policy of secrecy on the part of the US government. They have received extensive media coverage because they are (a) carried out in a third country and (b) often directed against individual targets such as Taliban commanders or suspected al-Qaida terrorists. The US attacks have come under particular criticism because they have caused unexpectedly high civilian casualties, and also because the attacks raise several questions under international law. In the following, we will investigate both of these aspects.

4.1.1 Heavy civilian casualties despite high-precision drone strikes?

Already under President George W. Bush, there had been drone attacks on Pakistani territory that, as shown in Graph 1, were even expanded considerably under President Barack Obama.



Graph 1: Development of drone strikes in Pakistani tribal areas (source: www.longwarjournal.org/pakistan-strikes.php; 11.2.2011)

Assessments vary when it comes to gauging the effectiveness of the strikes: Observers basing their estimates exclusively on evaluations of press reports believe that the strikes in Pakistan have so far killed between 1,320 (low estimate) and 2,049 people (high estimate).[9]

The share of civilian casualties remains controversial, with estimates ranging from nearly 100% (thus the Pakistani website pakistanbodycount.org)[10] to less than 10% (thus the conservative US website thelongwarjournal.org). No official figures have been released by the US government.

The problems associated with collecting accurate statistics in this context are immense:

> "Civilian casualties caused by US drone strikes are particularly difficult to verify. The majority of such strikes occur in North and South Waziristan, areas inaccessible to foreigners as well as most Pakistanis. Most estimates are based on media reports, which in

9 New America Foundation, The Year of the Drone, http://counterterrorism.newamerica.net/drones (8.2.2011).

10 However, a qualification is required: the methodology applied by the site counts dead Taliban as civilians. Cf. Shachtman 2010c.

> turn rely on a range of sources from government and army officials to militant commanders and local stringers." (Rogers 2010: 14)

Finally, the definition of the term "civilian" is not always clear. For instance, Rogers cites a "high level Pakistani official" as follows:

> "'Don't give shelter or protection to state's enemies…if they have an agent of al-Qaeda or whomever in their house, then that is the cost that they pay.'" (Quoted in Rogers 2010: 15). If this definition is taken as the basis, it must be assumed that the reported civilian victims are significantly higher than media reports would suggest, since suspected or supporters are listed in the statistics as actual Taliban. Nevertheless, despite all methodological problems, evaluation of media reports is the only way of approximating the actual figures. The most comprehensive investigation to date, a report by the New America Foundation based on press reports, stated in October 2009 that up to one third of the victims may have been civilians,[11] while more recent figures assume that approximately one quarter of victims were civilians over the entire period. Two points are noticeable when considering the suspected number of civilian casualties and the frequency of air strikes over time (Table 1):

Year	**2004-2007**	**2008**	**2009**	**2010**	**Overall**
estimated total death (low estimate)[12]	89	273	368	607	1,337
estimated total death (high estimate)	112	313	724	993	2,142
civilian casualties (low estimate)	8	157	120	26	311
civilian casualties (high estimate)	9	162	304	62	537
% civilian casualties of all casualties (low estimate)	9.3%	59.7%	29.1%	4.7%	23.2%
% civilian casualties of all casualties (high estimate)	8.3%	54.7%	42.9%	6.6%	25,1%

Table 1: Civilian Casualties in Pakistan Air Raids (Source: http://counterterrorism.newamerica.net/drones; own calculation)

First of all, it is noticeable that the share of civilian victims in the total number of casualties of drone strikes since the beginning of UAV missions over Pakistani territory was not constant, but – as shown in Table 1 – began at a low level, rose to nearly 60% in

11 New America Foundation, Revenge of the Drones, www.newamerica.net/publications/policy/revenge_of_the_drones (8.2.2011). Since all cited figures are based on eyewitness reports, however, neither the classification of casualties nor the fact of the strike actually having been carried out by a drone can be verified.

12 The indication of "high" or "low" estimate refers to the estimated *total* death from U.S. drone strikes in Pakistan and not to a high and low estimate of civilian casualties. See http://counterterrorism.newamerica.net/drones (8.2.2011) for methodological details.

2008, and then declined slightly in 2009 and significantly in 2010, regardless of whether the lower or higher estimates are taken into consideration. The second notable fact is that in absolute terms, the most civilian casualties occurred in 2008/09, while the absolute number of civilian casualties in 2010 is conspicuously lower.

Observers believe that the especially high number of civilian casualties in 2008/2009 is due to the use of particularly powerful bombs for reliable elimination of "high-value targets" – i.e., high-ranking al-Qaida leaders. It is also believed that the rules of engagement (see above) are not adhered to scrupulously in the case of attacks against alleged leadership cadres in order to ensure maximum probability of success. Finally, there are indications that the CIA has knowingly used software flawed by bugs and prone to malfunctions in its drones, although these charges are so far unsubstantiated (Ackerman 2010b).

In 2010, according to various estimates, the number of innocent Pakistanis killed by US attacks still ranged between 26 and 62 people, since the number of attacks has drastically increased (see above).

The future will tell whether the visible decrease of civilian victims as a percentage of total deaths indicates a trend reversal with overall increased precision, and whether closer scrutiny confirms the figures cited. On the one hand, it seems that the attackers are now relying on better informants on the ground who have been able to deliver more precise information on the whereabouts of high-ranking Taliban functionaries and thus made possible more precise drone attacks (Ackerman 2010a). On the other hand, one cannot exclude the possibility that large numbers of civilians have by now left the most heavily attacked areas, which of course would also diminish the likelihood of civilian casualties.

Overall, there has been a great deal of outrage among the local population concerning the attacks in Pakistan. Counterinsurgency experts even counseled against further drone attacks in 2009, since the radicalizing effect of civilian victims was greater than the advantages gained by the attacks (Kilcullen/McDonald Exum 2009). Even though these considerations are mere conjecture so far, it is conceivable that the radicalizing effects may be even higher due to the nature of the attacks (see below) than if civilians should fall victim to combat operations in the traditional sense.

The government in Islamabad has also distanced itself vocally and consistently from the US attacks in order to avoid being tainted by association with them. However, it is all but certain that the strikes are coordinated at least in principle and that the Pakistani government also receives reconnaissance intelligence from the US (Shachtman 2009). One could therefore also speculate whether local government officials may be intentionally leaking lower casualty figures to the media in order to conceal the true extent of the problem. Even though it is true that the use of drones and precision missiles in principle causes less civilian casualties than would be the case, for instance, with carped bombing or the use of "dumb" bombs, the question remains whether the requirement under international law to make every effort to minimize civilian casualties is truly being observed.

4.1.2 The aspect of international law

In addition to the question of civilian casualties, the drone attacks in Pakistan also raise considerable legal issues, which were even the subject of Congressional hearings in the US in March and April 2010.[13] The key question is whether the US authorities or armed forces fundamentally have the right to kill Taliban or al-Qaida terrorists in third countries – whether with drones or by other means.

Several US experts in international law, including Legal Advisor to the State Department Harold Koh, argue that the US is engaged in an "armed conflict with al-Qaeda, as well as the Taliban and associate forces" and therefore "may use force consistent with its inherent right to self-defense under international law" (Koh 2010). Against this background, he claims, it is legitimate to pursue Taliban units across the border, so long as Pakistan is not willing or able to combat the Taliban effectively, or if Pakistan has consented to such strikes. However, this line of argument is not, of course, limited to Pakistan, but essentially applies to all countries where al-Qaida cells are present. Thus, when asked in March 2009 about the veracity of claims that US drones operating from Afghanistan were attacking targets in neighboring Pakistan, Secretary of Defense Robert Gates responded:

> "Well, I can't talk about our military operations, obviously. But the president has made clear that we will go after al Qaeda and their planning cells and their training centers, wherever they are in the world."[14]

On the other hand, there are those who criticize that the targets include not only the Taliban, but frequently also al-Qaida terrorists who are not combatants under international law, but – strictly speaking – civilians, at least as long as they do not participate in the actual fighting. Targeted executions of civilians, even if they are designated "terrorists", is not permissible under international law and was explicitly banned by US President Gerald Ford in 1976 – though this injunction not written down in legally binding terms (Sharkey 2009: 17). The argument that under international law, al-Qaida members should be considered combatants in the "global war on terrorism", making them legitimate military targets, is at least highly controversial as they usually do not participate in actual fighting and do not pose an imminent threat . Thus, a UN study concludes:

13 The schedule of the hearings can be found at http://oversight.house.gov/index.php?option=com_content&view=article&id=621%3A03-23-2010-national-security-qrise-of-the-drones-unmanned-systems-and-the-future-of-warq&catid=17%3Asubcommittee-on-national-security&Itemid=1and http://oversight.house.gov/index.php?option=com_content&view=article&id=681%3A04-28-2010-qrise-of-the-drones-ii-examining-the-legality-of-unmanned-targetingq&catid=17%3Asubcommittee-on-national-security&Itemid=1 (18.2.2011).

14 U.S. Department of Defense, News Transcript, 31.3.2009, www.defense.gov/Transcripts/Transcript.aspx?TranscriptID=4392 (18.12.2010).

> "If states unilaterally extend the law of armed conflict to situations that are essentially matters of law enforcement that must, under international law, be dealt with under the framework of human rights, they are not only declaring war against a particular group, but eviscerating key and necessary distinctions between international law frameworks that restrict States' ability to kill arbitrarily" (UN Human Rights Committee 2010: 16).

And even the US government is inconsistent in its arguments. Many suspected al-Qaida members or Taliban fighters, having been captured, were not treated as "combatants" at all, but incarcerated as "unlawful combatants" in Guantanamo without the rights of a prisoner of war. Obviously, double standards are being applied here in terms of international law: If a targeted killing is to be justified, the combatant status is referenced; when the issue is treatment of prisoners, their rights, and international monitoring, the combatant status is negated (Glazier 2010). Finally, in her statement to the hearing on the "Rise of the Drones", international law expert Mary Ellen O'Connell pointed out that neither Pakistan, nor Yemen or Somalia, where drones have been and continue to be used for targeted assassinations of terrorists, are war zones – and stated that in her opinion, drones could be deployed exclusively on the battlefield (O'Connell 2010: 1). However, this position is also contested (cf., e.g., Glazier 2010).

Finally, O'Connell rejects the theory of legitimacy being derived through the (alleged) invitation of Pakistan:

> "... for much of the period that the United States has used drones on the territory of Pakistan, there has been no armed conflict. Therefore, even expressed consent by Pakistan would not justify their use" (O'Connell 2010: 3).

The second reason why the drone strikes in Pakistan are controversial under international law is that many of them are carried out not by the regular armed forces of the US Air Force, but by the CIA: CIA pilots steer the drones, CIA experts are in charge of reconnaissance, and CIA agents give the order to open fire. Some US experts argue that, since they consider the fight against the Taliban and al-Qaida to be *self-defense*, the CIA is legally permitted to participate in combat operations (Anderson 2010). However, if the assumption of an "armed conflict" is rejected (see above), another conclusion suggests itself: "Outside of armed conflict, killings by the CIA would constitute extrajudicial executions assuming that they do not comply with human rights laws. If so, they must be investigated and prosecuted both by the US and the State in which the wrongful killing occurred" (UN Human Rights Committee 2010: 21f).

However, even if one goes along with the assumption that terrorists and Taliban are fighters in an "armed conflict" that may be directly attacked, CIA agents are not members of the regular armed forces who, for instance, enjoy immunity under international humanitarian law for their actions, but civilians who essentially have no right to participate in combat operations. If they nevertheless do participate, they may be regarded as legitimate targets (at least as long as they are actively participating, see above) and may, unlike regular soldiers, be prosecuted for murder by the countries in which they have carried out targeted assassinations using drones (UN Human Rights Committee 2010: 22).

Finally, it is completely unclear to date whether the CIA applies similarly strict decisionmaking criteria in its missions as the military does to avoid civilian casualties.

Due to the intense secrecy involved, it is significantly more difficult to prove misconduct of the intelligence services than would be the case with regular armed forces units.

Thus, the use of the CIA as the executing agency of drone strikes in Pakistan introduces additional complications under international law, to say the least.

The analysis shows that the legality of strikes involving armed drones depends largely on who employs the drones in which context – and that modern high-tech weapons in particular create desires that apparently relegate considerations of international law to second place.

4.2 Proliferation and disinhibition: Additional Problems

In connection with the increasing technologization of war and the high-tech transformation of the armed forces, the possibility that lower risks to own troops could remove inhibitions concerning the use of the military was frequently referenced (e.g. Müller/Schörnig 2002). For instance, already in the 1990s, the administration of Bill Clinton had taken recourse again and again to air strikes using technologically advanced cruise missiles as a proven instrument of policy (Butfoy 2006). Neither is it an overbold statement to say that without an awareness of the US's overwhelming technological superiority, the White House would certainly have thought differently about attacking Iraq in 2003. This danger will be compounded in the future by the prospect of deploying armed drones and robots instead of human soldiers onto the battlefield. In this way, robots and drones will not only change warfare at the tactical level, but also affect the prior cost-benefit calculation of strategic decisionmaking and lower the threshold of inhibition when it comes to the use of force at the international level (Asaro 2008: 6ff.). Those who regard military solutions as a feasible option under certain circumstances may consider this a positive development: For instance, international law expert Claus Kreß, was quoted in the German weekly Frankfurter Allgemeine Sonntagszeitung with the question of whether the use of military robots in humanitarian disasters such as Kosovo and Darfur might not "create possibilities to launch a rescue operation that one might otherwise refrain from due to fear of losses to one's own side?".[15] Whether military interventions are appropriate for defusing humanitarian emergencies is another question altogether.

As far as the potential opponents and challengers to the US and the West are concerned, these current technological developments will trigger countermeasures. Some of these states, such as China, have already invested significant resources in the production of unmanned systems of their own. At the 8th China International Aviation

15 Quoted in: John Kantara: Maschinen mit Marschbefehl. Frankfurter Allgemeine Sonntagszeitung, 18 July 2010, p. 52.

and Aerospace Exhibition in Zhuhai in 2010, Chinese producers presented more than 25 different UAV models, including armed types.[16] Only a few years earlier, no drones had been exhibited at all. While many of the models are copies of Western drones (von Kospoth 2008), the production of indigenous types seems to be gaining momentum. However, whether the drones will be successfully integrated into a system of systems as achieved by the US for maximum exploitation of networking benefits is difficult to assess in light of the high development costs involved. However, it should be remembered that imitators usually incur lower costs, since first of all, they can develop their products in a more targeted manner following a pick-and-choose strategy, and secondly, they can avoid mistakes that the innovator invariably experiences. At least in the middle term, an arms race in this field might ensue between the US and China, possibly also Russia, over dominance in robotic arms (Thompson 2008).

But even if China is by now making huge efforts to transform its armed forces in line with the US high-tech paradigm, China has already assessed the current Western supremacy in the field of conventional weapons as a quite real threat to its own strategic nuclear arsenals (Tompkins 2003). The US capability to carry out a conventional disarmament strike certainly constitutes a strong incentive for the Chinese to upgrade their nuclear-armed submarine fleet. But in Russia, too, some experts are developing scenarios to evaluate the feasibility of a US conventional strike, using stealthy drones, against Russia's strategic nuclear arsenals.[17]

Thus, while China is pursuing a double strategy, other, less technologically advanced states can only fall back on "classic" mass casualty weapons to balance Western superiority. Attributing the current tendencies towards proliferation exclusively to Western superiority would certainly be a one-sided view. Nevertheless, the technological advantage that has allowed Western conventional armies to jump ahead of other armed forces is accelerating asymmetric reactions – e.g., the desire to procure mass casualty weapons – and puts pressure on existing arms control regimes (Müller/Schörnig 2001).

However, the increasing use of unmanned drones and robots also provokes other asymmetric reactions. The phenomenon of a militarily inferior side, faced with an external superior adversary, switching to guerilla tactics, assassinations, and ambushes is as old as warfare itself, with examples ranging from the Battle of the Teutoburg Forest to the use of IEDs and suicide bombings in Afghanistan and Iraq. However, historically, it was usually the superior *forces* on the ground that were targeted by ambushes. But the more the troops of the dominant side withdraw from the battlefield and allow machines to take their place, the more incentive there is for the inferior side to carry the conflict into the home countries of the invading troops (Kahn 2002). Therefore, terrorism experts

16 DefenseNews, Zhuhai Airshow Goes Unmanned, 16 November 2010, www.defensenews.com/story.php?i = 5056235 (9.2.2011).

17 Author's personal communication with a Russian expert.

perceive a danger that the number of attacks against civilian targets in Western countries will increase as the automation of warfare progresses.

In view of the unequal battle between humans and machines, it should come as no surprise that tactics perceived in the West as particularly "cowardly", such as booby-traps and ambushes, are regarded as legitimate and justified methods of warfare by the Taliban. From their point of view, these methods are no worse or more cowardly than a drone strike that literally comes like a bolt from the blue, where not even the pilot incurs any personal risk. Neither is there any confirmation of the notion that such drone strikes might demoralize an enemy who is practically defenseless and exposed to them (Singer 2009a: 298ff.). On the contrary: There are indications that the use of drones is especially effective as a recruitment tool for insurgents, since drone warfare is seen as a particularly arrogant form of the "show of force" (Kilcullen/McDonald Exum 2009).

Even though such notions of justice and "honorable-heroic" battle are regarded as archaic and obsolete by Western "post-heroic" societies (Luttwak 1995), Western decision-makers do have to be aware that the use of fighting machines serves to spur resistance rather than reducing it and can thus contribute to escalating the conflict.

A particularly troubling aspect of the increasing use of warrior robots is the widespread perception among civilians that Western troops are concerned primarily with their own protection rather than the protection of the civilian population. The general impression is that Western troops are hiding behind their technology, which has caused a severe loss of trust in many parts of the world (Kilcullen/McDonald Exum 2009). The soldiers with their bulletproof vests, protectors, helmets, sunglasses, and high-tech equipment have an overly warlike and inhuman appearance. Only recently, the Pentagon issued orders for soldiers to remove their sunglasses when speaking to civilians in order to establish human rapport via eye contact (Boone 2010). However, the more robots accompany patrols or even carry out that task without being accompanied by humans, the greater the distrust will be against locally deployed soldiers. Finally, Western arms corporations like to suggest that their systems are practically flawless and have thus contributed to creating expectations that the machines cannot but fail to meet. If, despite the high state of technology used by the Western forces, errors ensue that lead to high civilian casualties, the population will likely react with very little understanding (Human Rights Watch 2008: 2). The impression may even arise that the "mistakes" were made intentionally, which will drive new recruits into the arms of the insurgents.

4.3 Future problems arising from greater autonomy

If systems are imbued with greater autonomy, further-reaching questions and problems arise – especially if these systems are entrusted with independent decisionmaking concerning the use of weapons. As already mentioned above, there has been no discussion in international law so far concerning the problem of robot warriors, and the existing rules on proportionality and distinction under international law are applied. Therefore, for autonomous systems, too, the distinction between combatants and non-combatants,

military and civilian installations etc. is mandatory. It is an extremely controversial question whether future autonomous systems operating without any human support will even be able, first of all, to assess when a target is of such high value that it can be attacked despite the risk of civilian casualties and when it is not (Sharkey 2009: 18f.) and secondly, to make a reliable distinction between combatants and non-combatants (Sharkey 2008). Even for humans, it is difficult to make the distinction in current conflicts between dangerous insurgents and terrorists on the one hand and innocent civilians on the other. Often, a great deal of experience and concomitant intuition is required to identify an adversary as such before it is too late – it would seem difficult to communicate this knowledge to a robot. While some experts in robotics believe that technical solutions may be found in the future that would allow robots to act in accordance with international law (Arkin 2009), critical experts doubt that even more powerful processors and programs will be capable of dealing with this complex task in a satisfactory manner (Sharkey 2008). The risk of "accidents" up to and including uninhibited massacres would be, in a way, pre-programmed and quasi-inevitable.

In addition to the purely technical aspects, there is also a closely linked ethical dimension that needs to be taken into consideration, but has so far attracted little attention: Should robots be permitted to make judgments over life and death? And if so, who carries responsibility for their decisions? Already in the 1940s, writer Isaac Asimov formulated the fictional Three Laws of Robotics, which he defined as the ethical foundations of interaction between robots and humans. Asimov's "Laws" have become so popular that they serve today as the basis of discussion for dealing with robots even in the disciplines of robotics, philosophy, and law (Wallach/Allen 2009: 3f.).

According to these laws,

1. A robot may not injure a human being or, through inaction, allow a human being to come to harm.
2. A robot must obey any orders given to it by human beings, except where such orders would conflict with the First Law.
3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.[18]

Obviously, these laws are diametrically opposed to the notion of deploying military combat robots and would even outlaw the deployment of armed robots per se. The practical prospects of that happening are zero, considering the current armaments dynamic. For too long, the ethical problem has been dismissed as "science fiction", only to be rapidly overtaken by real events.

This shifts the ethical focus to the second question of allocating responsibility. Bioethicist Robert Sparrow argues that complex autonomous machines undermine the

18 Cf. the "Robot" series by Isaac Asimov.

principle of imputing responsibility in case of war crimes. As he sees it, the notion of an ethically "just" war (as formulated by Michael Walzer) also implies that a concrete person will assume responsibility for human casualties – for the killing of enemy troops and even more so for the killing of civilians. That, he argues, is the least that one owes one's adversary, and he continues "[i]f the nature of a weapon, or other means of war fighting, is such that it is *typically* impossible to identify or hold individuals responsible for the casualties that it causes then it is contrary to this important requirement of *jus in bello*. It will not be ethical to employ this means in war" (Sparrow 2007: 67).

The problem that arises here is that with more complex robots, it becomes increasingly difficult to predict their behavior in a given situation, since the purpose of autonomy is to give machines leeway in action. However, then the following questions arise (Sparrow 2007: 69): Who is to blame if such a robot engages in illegitimate behavior, e.g., targeted killing of civilians? Who could be charged with war crimes in a proper court of law? Since the machine cannot, at least at the current state of technology, take responsibility for its own actions, the intuitive answer is that the designers or the officers that gave orders for their deployment should be charged. However, Sparrow argues that the increasing autonomy of the robot progressively relieves these two groups of actors of their responsibility, since the robot's actions in practical situations is intentionally left to become more and more unpredictable (Sparrow 2007). After all, it is precisely intended that the robot itself should decide on how to achieve its goal – even if humans would have decided otherwise. With a view to the initial quotation, robots are then indeed programmed to do anything, but they do not necessarily carry out the intentions of the programmer or user, but act as they themselves see fit. Even if technicians refer to the possibility of "flawless" code and experts discuss the prospects of robots being programmed to act "ethically", the basic problem remains unresolved: If responsibility for life and death no longer lies with humans who have a conscience, then, as Sparrow argues convincingly, the use of such autonomous killer robots is unethical and dangerous, and must be rejected.

Paul W. Kahn, an expert in international law at Yale University, has introduced an interesting idea that has, however, received little attention so far: He argues that the right of a soldier to kill in war is essentially derived from the right to self-defense, and thus postulates a reciprocal risk of being killed (Kahn 2002: 3). Considering the new type of warfare where one's own troops enjoy maximum protection form the risk of war, Kahn concludes: "Without the imposition of mutual risk, warfare is not war at all. What is it then? It most resembles police enforcement" (Kahn 2002: 4). And further, he argues: "In situations of extreme asymmetry, the distinction between combatants and noncombatants loses its value for moral discrimination. […] If combatants are no longer a threat, […] then they are no more appropriate targets than noncombatants" (Kahn 2002: 5). Clearly, while Kahn is arguing in terms of international law, his argument is essentially an ethical one that can already be applied to armed remote-controlled drones, i.e., that does not,

unlike Sparrow's argument, presuppose the existence of sophisticated artificial intelligence. Thus, his line of reasoning is criticized by experts in international law, who respond that Kahn's argument is outside of the boundaries of classic international law.[19] Nevertheless, it is of course legitimate to ask to which extent even a form of warfare conducted by humans whose own blood is not at risk of being shed meets minimal ethical criteria.

5. Slim chances for arms control

Robotics and autonomous systems are entering the arsenals of Western as well as, with a slight delay, of non-Western states at breathtaking speed. So far, most states are still concentrating on unarmed systems. However, it is likely to be only a matter of time before armed combat robots are part of the standard military inventory in NATO and OECD states. The increasing autonomy of systems is celebrated enthusiastically, and criticism is dismissed with the observation that current robots are only the first generation. Critics are told to wait and see what capabilities the next generations will have to offer.

Against this background, the option of arms control measures is barely discussed at all, and even among those states that have otherwise been particularly amenable to arms control measures at the international level, there is strong interest in procuring drones of their own.

5.1 The case of Germany

The German armed forces (Bundeswehr), too, have recognized the importance of autonomous systems especially for an army deployed on the battlefield and are devoting increasing attention to the issue. Today, the Federal Ministry of Defense is also considering equipping the Bundeswehr with armed drones. On 1 August 2008, the US Defense Security Cooperation Agency, which is subordinate to the Pentagon, issued a press release announcing that Congress had been informed of a German inquiry concerning the possibility of purchasing five Reaper drones, which may also be equipped with weapons.[20] This is particularly interesting when considering that the federal government, which at the time still consisted of a grand coalition of Christian Democrats and Social Democrats, responded in March 2009 to a minor interpellation by the Green faction by saying that no military or security-policy risks were expected, since UAVs and

19 Author's personal communication with several experts in international law.

20 See www.dsca.mil/PressReleases/36-b/2008/Germany_08-59.pdf (10.2.2011).

unmanned vehicles were only "technical solutions and not a new capability".[21] Also, the federal government sees no necessity to place the issue of autonomous military systems on the international arms control agenda or to undertake arms control policy initiatives of its own. For "no humanitarian risks have been identified that might conflict with the concept of protecting our own soldiers by deploying UAVs/UCAVs."[22]

On the contrary: Two lieutenant colonels reported the journal "Hardthöhenkurier" (which has close ties to the armed forces) that the air force (Luftwaffe) was observing "the technological development in connection with 'weaponized' UAVs for effect against targets and SEAD [suppression of enemy air defense] with particular interest, since that is where their introduction is currently seen to offer the greatest added value" (Geiß/ Theisen 2010: 35). This assessment reflected the personal opinions of the two officers rather than the official view of the Defense Ministry; however, the statement included in the federal government's response to the Green party's interpellation (quoted above) that "[t]he planning data for the Bundeswehr (BWPlan) of 2009 depicts a planning reserve to be used from 2016 onwards for a multi-purpose platform Luftwaffe Unmanned Combat Aircraft Vehicle"[23] also indicates that armed drones and robots will be introduced to the Bundeswehr as well sooner or later.[24]

At least the Office of Technology Assessment at the German Bundestag is currently conducting a study commissioned by the Defense Committee on the "State and Prospects of Military Use of Unmanned Systems" that appears to address some of the problems outlined above. However, this study, which was due for 2010, has not been published yet and it remains to be seen whether the study will have any significant impact on the policies of the federal government. That depends largely on whether the members of parliament will allow themselves to be caught up in the fervor for the new systems or manage to maintain a critical detachment.

5.2 Limitations and possibilities of arms control

However, the chances of reaching an international agreement on limitations appear quite grim if even countries that have traditionally been active in promoting arms control policies, such as Germany, play down the dangers of an increasingly dynamic buildup of

21 Deutscher Bundestag,16. Wahlperiode, Antwort der Bundesregierung auf eine kleine Anfrage der Abgeordneten Alexander Bonde, Winfried Nachtwei, Omid Nouripour, weiterer Abgeordneter und der Fraktion BÜNDNIS 90/DIE GRÜNEN, Einführung und Bedeutung unbemannter militärischer Fahrzeuge und Luftfahrzeuge. Drucksache 16/12481, 26 March 2009. Response to question 24.

22 Cf. fn. 20, answer to question 30.

23 Cf. fn. 20, answer to question 16.

24 A "planning reserve" (Planungsvorbehalt), however, does not constitute a legal obligation but rather an expression of political will.

robotic weapons, or refuse to acknowledge them, or at least subordinate these dangers to expected benefits and therefore aim to acquire systems of their own. The past has shown that multilateral arms control can only make significant progress if some states decide to lead the way courageously by keeping the issue on the agenda and convince their allies to follow suit. So far, the prospects of arms control involving drones are very bleak; only few existing treaties deal with such weapons systems at all (Gormley/Speier 2006). However, concrete arms control proposals are scant and debate mostly focused on preventing proliferation[25] rather than on limiting the acquisition of robot weapons as such and for their own sake.[26] However, most of the few experts dealing with these questions agree that an "outright ban" is not a sensible alternative. Thus, for instance, Armin Krishnan, the author of one of the standard works in the field, argues: "It would be both ethically questionable and militarily unwise for Western states to simply renounce the use of armed military robots completely. At the same time, it would be very complacent and irresponsible to leave such a potentially very powerful military technology like military robotics largely unregulated" (Krishnan 2009: 158).

Critical researchers at the *International Committee for Robot Arms Control* (ICRAC) outlined the possible parameters of an international regime for controlling robotic arms at an expert workshop in Berlin in autumn 2010 and offered some fundamental deliberations as to which aspects of future development should be prohibited and which should be restricted.[27] Also, some experts have made proposals for technological restrictions designed to find a compromise between the requirement for drones and the prevention of destabilizing developments (Altmann 2009; Sparrow 2009). These often quite technical deliberations are important, but are still at an early stage and so far largely ignored by policy-makers. It is doubtful whether this will change in the foreseeable future: First of all, the development of autonomous machines in the civilian sector cannot be inhibited. The fascination of robotics and of the tension between man and machine seems too great; the vast number of books and films on this subject illustrate its attraction for many. Even critical researchers cannot always escape this fascination: Thus, one pertinent book by US expert Peter Singer begins with the author asking himself why he wants to write a book about robots and war. The answer is short and succinct: "Because robots are frackin' cool!". A future without autonomous robots no longer seems conceivable at this point. Secondly, the short-term military and also political benefits expected from the replacement of human soldiers by their electronic counterparts are too great to be forgone

25 Thus, the two Western-dominated export control regimes of the Wassenaar Agreement and the Missile Technology Control Regime (MTCR) have for some years also covered UAVs and the components necessary for their construction. See www.mtcr.info/english/objectives.html; www.wassenaar.org/controllists/Previous/2008_OK/WA-LIST (08) 1.pdf (10.2.2011).

26 A laudable exception is the work of Armin Krishnan (2009: 156-165), who discusses the issue of arms control systematically, though somewhat briefly.

27 ICRAC, Expert Workshop Statement, 22.9.2010, www.icrac.co.cc/Expert%20Workshop%20Statement.pdf (11.2.2011).

by Western politicians in particular. Especially because the pressure to justify the military operations in Afghanistan and Iraq is constantly increasing, the vision of a "bloodless war" (Mandel 2004) seems all too tempting.

If a buildup of robot arms cannot be prevented, the only alternative is to begin by creating awareness of the real dangers and ethical problems in order to lay the groundwork for a revision and voluntary self-restraint. Only when the Western countries that are driving the development realize that it is in their interest to voluntarily restrict themselves and to openly and transparently renounce particularly destabilizing developments – e.g. especially small UAVs suitable for individual assassinations or armed drones that can patrol outside the sovereign territory of a state and thus facilitate an attack on strategic arsenals at very short notice (Kewis/Postol 2010) – will there be a realistic chance of imposing arms control. A first step would be for the countries that deploy armed UAVs or other robots to arrive at a moratorium or international agreement that even with autonomous systems, the ultimate decision on the use of weapons must always remain with a human being in order to have a final responsible authority with unambiguous responsibility.

In a further step, an agreement could be reached to preserve the video footage of armed drone missions for a minimum duration, to impose penalties for electronic tampering with this data, and to make the data available to domestic oversight authorities. It is also conceivable that the data could be provided to a UN body (yet to be established) in order to ensure independent oversight. It remains to be seen whether such a demand is realistic in an age characterized by the non-transparent use of special forces, "black ops", and drones. The alternative, which is even less palatable to politicians and military leaders alike, is the uncontrolled leaking of incriminating material on the internet. Thus, the internet platform Wikileaks in 2010 published a classified US military video of a US Apache helicopter attacking unarmed civilians in Baghdad – including journalists of the Reuters news agency.[28]

Any way one looks at the issue and which form of limitation on robot arms one favors: What matters most is that the issue must be tackled while the "West" still has some leeway and can define basic rules. The more states catch up with the current Western developments, the more difficult it will become to agree on concrete measures. If that does not happen, a similar development may ensue as in the case of "cyberwar". For many years, Western politicians, but also military leaders considered this topic to be "science fiction" that could be safely ignored. Critical publications and the early call for arms control were left unheeded (Minkwitz 2003). Only in recent years, especially since the Stuxnet event in late summer 2010, when a computer virus of unknown provenance caused significant damage to Iran's uranium enrichment plants, have politicians

28 The video was released by Wikileaks under the title "Collateral Murder". See/www.collateralmurder.com (11.2.2011).

discovered the issue. They are now clamoring for suggestions on arms control policy.[29] Much time has been lost here, and a similar development seems to be in the offing with regard to drones.

6. The abiding illusion of a winnable war

The RMA and the gamble that weaponized drones will be a key instrument of warfare and the resulting trend towards robotization and automation are writing the latest chapter of a never-ending story in human development: the dream of a bloodless war with a guarantee of victory. In modern-day democracies, technological capabilities combine with the desire for a bloodless victory and the hope of serving the greater good of humanity: Enforcing justice, vanquishing tyrants, protecting the oppressed, and imposing state or social order where chaos prevails. The combination of both elements – good intentions and sparing means – is a particularly dangerous source of illusions.

Carl von Clausewitz already knew that innovation and technological progress would change the conduct of war, but not its nature:

> "The necessity of fighting very soon led men to special inventions to turn the advantage in it in their own favour: in consequence of these the mode of fighting has undergone great alterations; but in whatever way it is conducted its conception remains unaltered, and fighting is that which constitutes War."

And Clausewitz continues to explain:

> "Fighting has determined everything appertaining to arms and equipment, and these in turn modify the mode of fighting; there is, therefore, a reciprocity of action between the two. Nevertheless, the fight itself remains still an entirely special activity, more particularly because it moves in an entirely special element, namely, in the element of danger."

It precisely this aspect of danger that has been and continues to be displaced by the fixation on high-tech drones and robot warriors. However, the imposition of order will always require extensive risky deployment, resulting in high risks for one's own troops and for the civilian population that is to be protected. Technical superiority is only of limited value against a determined adversary. And after some delay, the opponent will also benefit from advances in military technology, as Israel has experienced at great cost in various drone strikes carried out by Hamas (Rubin 2007: 21f.).

Western decision-makers would be well advised to act now and voluntarily submit to a more restrictive handling of research, development, procurement, and deployment of armed and automated drones before they must concede the initiative to other states that will by then have drawn level with them.

29 Author's personal communications with political and federal administration representatives.

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